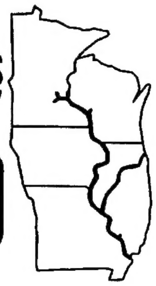

Long Term Resource Monitoring Program

Program Report

2000-P002

1997 Annual Status Report

Status and Trend of Submersed and Floating-leaved Aquatic Vegetation in Thirty-two Backwaters in Pools 4, 8, 13, and 26 and La Grange Pool of the Upper Mississippi River System

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1997 Annual Status Report:
Status and Trend of Submersed and Floating-leaved Aquatic Vegetation in Thirty-two Backwaters in Pools 4, 8, 13, and 26 and La Grange Pool of the Upper Mississippi River System

by

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June 2000

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Preface

The Long Term Resource Monitoring Program (LTRMP) was authorized under the Water Resources Development Act of 1986 (Public Law 99-662) as an element of the U.S. Army Corps of Engineers' Environmental Management Program. The LTRMP is being implemented by the Upper Midwest Environmental Sciences Center (UMESC), a U.S. Geological Survey science center, in cooperation with the five Upper Mississippi River System (UMRS) States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The U.S. Army Corps of Engineers provides guidance and has overall Program responsibility. The mode of operation and respective roles of the agencies are outlined in a 1988 Memorandum of Agreement.

The UMRS encompasses the commercially navigable reaches of the Upper Mississippi River, as well as the Illinois River and navigable portions of the Kaskaskia, Black, St. Croix, and Minnesota Rivers. Congress has declared the UMRS to be both a nationally significant ecosystem and a nationally significant commercial navigation system. The mission of the LTRMP is to provide decision makers and river managers with information for maintaining the UMRS as a sustainable large river ecosystem given its multiple-use character. The long-term goals of the Program are to understand the system, determine resource trends and effects, develop management alternatives, manage information, and develop useful products.

This report presents the results of aquatic vegetation transect surveys conducted in 1997 by field station personnel under the direction of the UMESC. Selected areas in Pools 4, 8, 13, and 26 of the Upper Mississippi River and La Grange Pool on the Illinois River were surveyed. This report satisfies, for 1997, Task 2.2.4.6, *Evaluate and Summarize Annual Present-day Results* under Goal 2, *Monitor Resource Change* of the Operating Plan (U.S. Fish and Wildlife Service 1993). The purpose of this report is to provide a summary of data regarding the distribution and abundance of submersed aquatic vegetation collected from the field stations for 1997. This report was developed with funding provided by the Long Term Resource Monitoring Program.

1997 Annual Status Report

Status and Trend of Submersed and Floating-leaved Aquatic Vegetation in Thirty-two Backwaters in Pools 4, 8, 13, and 26 and La Grange Pool of the Upper Mississippi River System

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Abstract: Thirty-two backwaters of the Upper Mississippi and Illinois Rivers were monitored for the seventh consecutive year in 1997 to determine the status and trend of changes of submersed and floating-leaved aquatic vegetation. Aquatic vegetation was sampled at regularly spaced sites along permanent transects established in previous years. Species compositions, frequencies of individual species, and the frequencies of sites that supported aquatic vegetation in 1997 were calculated and compared with results from previous years. The status and trend of aquatic vegetation in 1997 varied among the thirty-two backwaters. In general, the frequencies of sites that supported aquatic vegetation in 1997 in the backwaters of Pools 8 and 13 were at or near their highest levels recorded since 1991. In contrast, the frequencies of sites that supported aquatic vegetation in 1997 in the backwaters of Pools 4 were at or near their lowest levels recorded since 1991, despite four of the eight backwaters being in better condition than in 1996. Aquatic vegetation was rare in Pool 26 and La Grange Pool in the 1990s. The monitored backwaters of Pool 26 and La Grange Pool represent the few places where sizable aquatic vegetation beds were found in their respective river stretches when the transects were established in 1991 and 1992. In 1997, aquatic vegetation was present in two of the four backwaters of Pool 26. The other two backwaters of Pool 26 have not supported aquatic vegetation since after a long-duration flood in 1993. Aquatic vegetation was present in two of the four backwaters of La Grange Pool, but disappeared completely from the third backwater in 1997 and from the fourth (a channel border area) in 1995.

Key words: Annual report, aquatic, floating-leaved, LTRMP, Mississippi River, submersed, vegetation

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Introduction

Aquatic vegetation in the Upper Mississippi River System (UMRS) has been monitored as part of the Long Term Resource Monitoring Program (LTRMP) since 1989. The 1997 growing season is the seventh consecutive year aquatic vegetation was monitored in selected backwaters for LTRMP. A report to summarize each year's data is a Program requirement, and this report satisfies the requirement for 1997 (U.S. Fish and Wildlife 1993).

The sampling scheme is referred to as transect sampling because sampling is conducted along permanent transects. The objective of the transect sampling is to reveal the status and trend of changes of the aquatic vegetation in the UMRS backwaters. This annual report provides basic data summaries, including the species composition of aquatic vegetation, species frequencies of presence, and the frequencies of presence of submersed or floating-leaved aquatic vegetation in individual backwaters.

Historical Perspective

Illinois River

A detailed description of the geological history and changes during the past 2 centuries of the Illinois River is in Bellrose et al. (1979) and Mills et al. (1966). The Illinois River has numerous backwater lakes, many of them expansive. Until the beginning of the 20th century, the backwaters were high-quality, near-pristine habitats for aquatic plants. A sequence of overlapping catastrophic events, however, drastically reduced and degraded the river's natural habitats.

Before 1900, a series of low-head dams were built at Marseilles, Henty, Copperous Creek, La Grange, and Kampsville. On January 1, 1900, completion of the Chicago Sanitary and Ship Canal allowed for diversion of water from Lake Michigan, washing sewage downstream and raising water levels along the Illinois by several feet. Subsequently, the river and its backwaters were severely polluted. Beginning in the 1900s, backwaters were isolated from the river with levees and dewatered for agriculture. This, coupled with completion of the locks and dams from Dresden Heights to La Grange in the 1930s, added to the alteration of the river and its floodplain. Submersed aquatic plants began to disappear from the river as early as 1915 (Richardson 1921). Aquatic and marsh vegetation all but disappeared from the Illinois River during the period between 1920 and 1952.

Pollution from sedimentation presently is more troublesome than urban and industrial pollution because the former is cumulative. Storage capacity within the remaining bottomland lakes along the Illinois has been greatly reduced because of sedimentation. No new backwaters are being formed because of levees and other structures in and along the rivers. Many of the remaining backwaters are controlled to various degrees by levees, water gates, and water pumps. The hydrograph of the modern river is much more spiky and erratic than that of the natural river. Although water quality has improved over the last 20 years, sizable vegetation beds are still rare.

Upper Mississippi River

In contrast with the Illinois River, the Upper Mississippi River harbors more extensive submersed aquatic vegetation now than it did under natural (preconstruction) conditions. Before the 1930s, when the river was not impounded, most of the backwaters and marshes were flooded in spring and dried out in summer and fall. Water-level fluctuations and seasonal drying periods limited the development of aquatic plants in the backwaters (Green 1947). During the 1930s, a series of low-head dams were constructed to raise the water level during low discharges so a 9-foot-deep (minimum) navigation channel could be maintained. The impoundment of the river has created, and since maintained, additional backwater and marsh areas.

Aquatic plants initially prospered because water levels were more stable. Sustaining the quantity and quality of aquatic areas in the Upper Mississippi River, however, is a matter of concern for a number

of reasons. Structures have altered the scouring and deposition dynamics of the natural river, which will likely inhibit the formation of new backwater areas. Bathymetric diversity in the impounded areas is declining and commercial towboat and recreational watercraft traffic is predicted to increase. Consequently, water turbidity may be increased by amplified wind-fetch effect. The LTRMP was created in response to these and other concerns (Rasmussen and Wlosinski 1988). Identifying the trends of changes of the UMRS biological resources is one of the primary goals of the LTRMP (U.S. Fish and Wildlife Service 1993).

Study Areas

The LTRMP has six trend analysis areas, referred to herein by the navigation pool designations according to the U.S. Army Corps of Engineers lock and dam system. They are Pools 4, 8, 13, and 26 and the Open River on the Mississippi River and La Grange Pool on the Illinois River (Figure 1). Pool 26 also includes 12 miles of the lower Illinois River upstream of its confluence with the Mississippi River. The backwaters selected for aquatic vegetation monitoring are distributed in five of the six LTRMP trend analysis areas. The Open River LTRMP trend analysis area is not included in aquatic vegetation monitoring because it lacks any sizable backwaters or stable aquatic vegetation beds connected with the river.

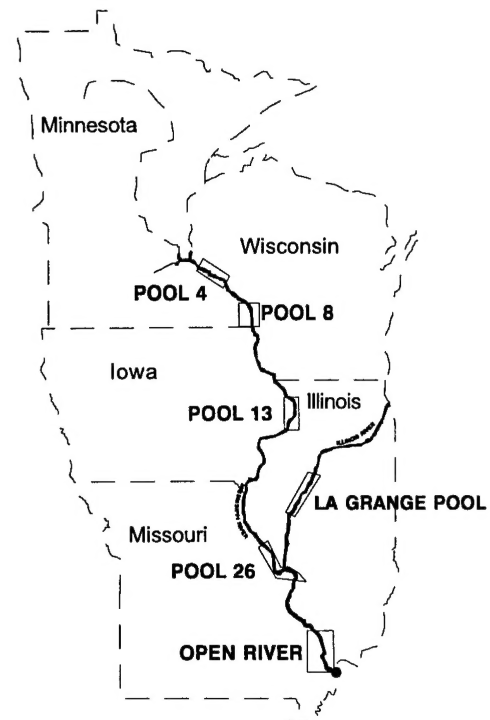

Figure 1. Location of Navigation Pools 4, 8, 13, and 26 and La Grange Pool in the Upper Mississippi River System where aquatic vegetation was surveyed, Long Term Resource Monitoring Program, 1997.

Seven backwaters were surveyed in Pool 4 in 1997 (Figure 2). Dead Slough Lake, Goose Lake, Mud Lake, and Catherine Pass (referred to as Bay City Flats in reports of monitoring before 1995 [Rogers et al. 1998; Appendix A]) are upstream of Lake Pepin. (Lake Pepin is a large tributary delta lake created by the deposition of vast amounts of sand at the confluence of the Chippewa and Mississippi Rivers, near the center of Pool 4.) The other three backwaters, Robinson Lake, Peterson Lake, and Big Lake are below Lake Pepin. Big Lake consists of a complex of smaller backwaters where three clusters of transects were established, including one cluster in Rice Lake and another in Big Lake Bay. Because Rice Lake and Big Lake Bay are similar in habitat conditions and differ from the rest of Big Lake, and because sample sizes from the two areas are individually small, Rice Lake and Big Lake Bay are treated as one backwater separate from the rest of Big Lake: Rice Lake–Big Lake Bay. The transects in Peterson Lake were also divided into Lower and Upper Peterson Lake groups and treated as two separate backwaters. All seven backwaters have been surveyed every year since 1991. In addition to the seven backwaters, Upper Mud Lake was surveyed from 1993 to 1996. Surveying of Upper Mud Lake was discontinued in 1997 because it is semi-isolated and atypical of backwaters in upper Pool 4 and access and sampling became excessively difficult. Consequently, the transects in Pool 4 were grouped into nine backwaters in analysis and reporting. A Habitat Rehabilitation and Enhancement Project (HREP), which involved dredging part of Big Lake Bay, was completed in spring 1993. Construction of an HREP in Peterson Lake in fall 1995 required relocating the first transect downstream about 30 m.

Eight backwaters were surveyed in Pool 8 in 1997 (Figure 3). Target Lake, Lawrence Lake, a

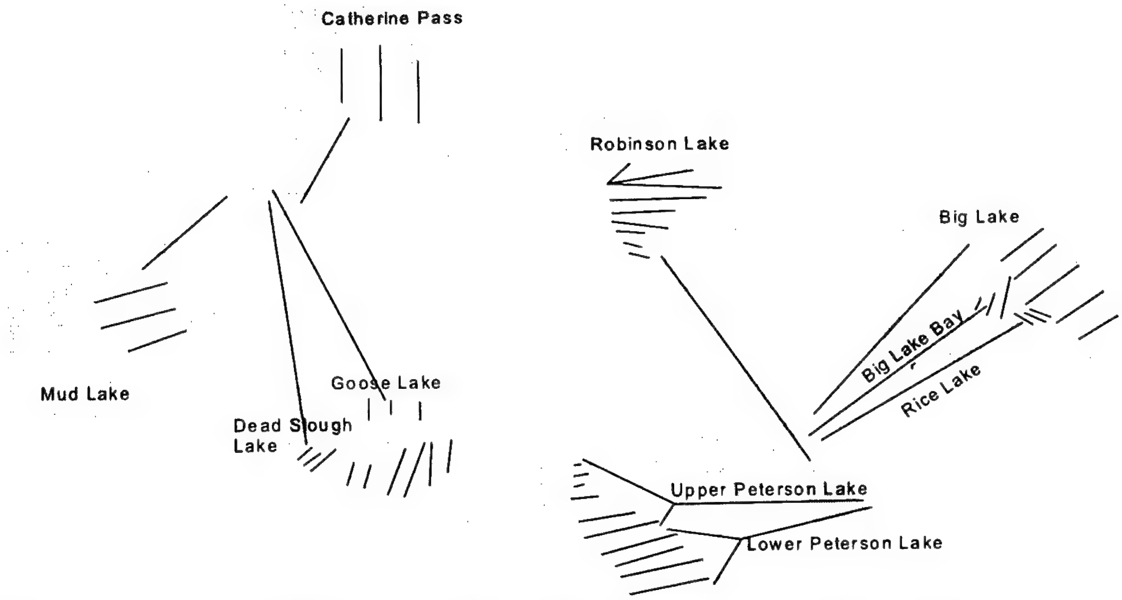

Figure 2. Location and arrangement of transects in Pool 4 (Upper Mississippi River) in 1997.

backwater near Goose Island (herein referred to as the Goose Island backwater), and Shady Maple are all backwaters contiguous to the main channel (Appendix A). Blue Lake and a backwater near Stoddard, Wisconsin (herein referred to as the Stoddard backwater), are isolated from the main channel. Transects established in the interior of Horseshoe and Boomerang Islands are in the impounded area of Pool 8. Target Lake, Lawrence Lake, Goose Island backwater, Shady Maple, and Horseshoe Island have been surveyed every year since 1991. The Stoddard backwater was added in 1992 and Blue Lake and Boomerang Island were added in 1993. Horseshoe Island and Boomerang Island are part of the Pool 8 Islands HREP.

Seven locations were surveyed in Pool 13 in 1997 (Figure 4). Brown's Lake, Savanna Bay, and Spring Lake are contiguous with the main channel, whereas Pomme de Terre, Potter's Marsh, Johnson Creek, and Johnson Creek Levee are in the impounded areas of Pool 13 (Appendix A). Brown's Lake and Potter's Marsh are HREP sites begun in 1988 and 1994,

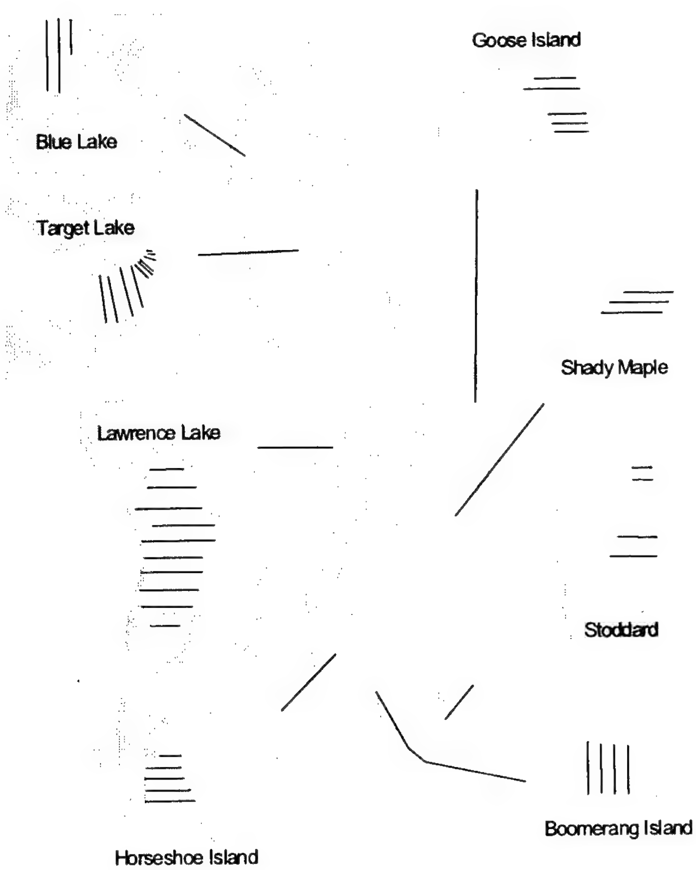

Figure 3. Location and arrangement of transects in Pool 8 (Upper Mississippi River) in 1997.

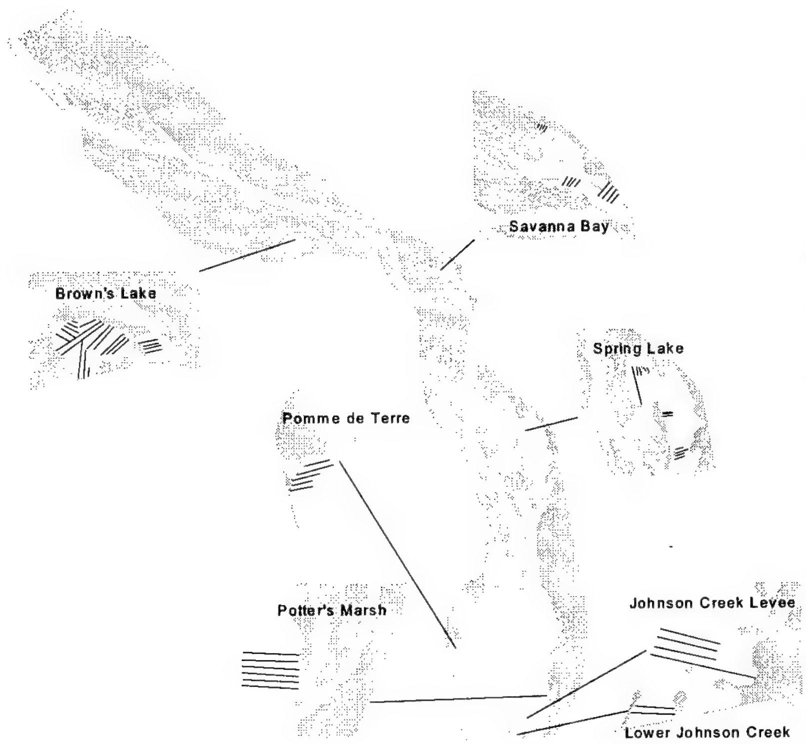

Figure 4. Location and arrangement of transects in Pool 13 (Upper Mississippi River) in 1997.

respectively. Transects in all seven locations were established in 1991.

Four backwaters were surveyed in Pool 26 in 1997 (Figure 5). Pool 26 includes portions of both the Mississippi and lower Illinois Rivers. The 4 backwaters were in the lower 12 miles of the Illinois River. Fuller Lake, Calhoun Point, and Stump Lake are isolated from the flow of the Illinois River and are managed as moist soil units (mainly to mimic preimpoundment conditions). The Calhoun Point area consists of several backwater lakes, sloughs, and ephemeral ponds. The fourth backwater, Swan Lake, is a large shallow area contiguous with the Illinois River. Although not presently managed as a moist soil unit, Swan Lake is difficult to access during low water levels in the summer. Also, Swan Lake was undergoing HREP modifications, including a levee system that will convert this backwater to noncontiguous status. The levees and pumps will allow for moist soil unit management after 1998. Stump and Fuller Lakes were not sampled during summer 1997 because of low water levels. The Calhoun Point, Stump Lake, and Swan Lake transects were all established in 1991 (Appendix A). Fuller Lake was added in 1992.

Four backwaters were surveyed in La Grange Pool in 1997 (Figure 6; Appendix A). Banner Marsh and Spring Lake have been completely isolated from the flow of the Illinois River by agricultural levees for at least 5 decades. Point Lake is separated from the Illinois River by agricultural levees that have been overtopped frequently by flooding water. The Grape Island location is a main channel border area and therefore directly affected by the river's flow. Banner Marsh was being modified as part of an HREP. Transects in Spring Lake, Point Lake, and Banner Marsh were established in 1991. Grape Island has been surveyed every year since 1992.

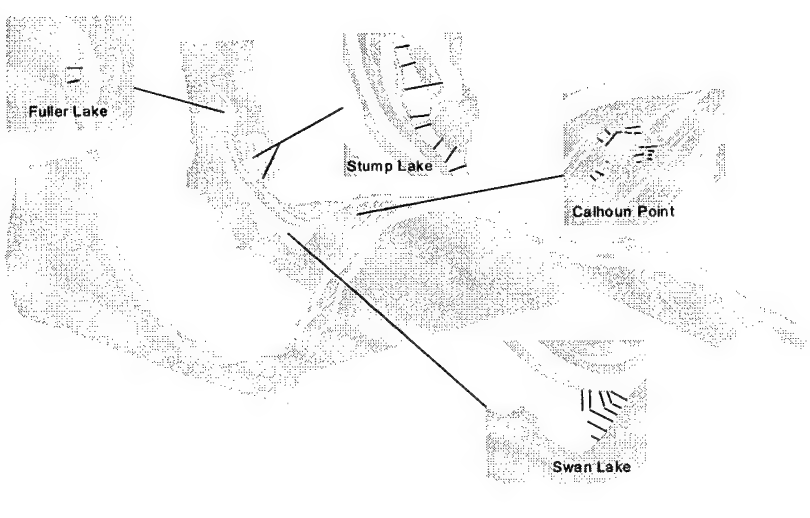

Figure 5. Location and arrangement of transects in Pool 26 (Illinois River) in 1997

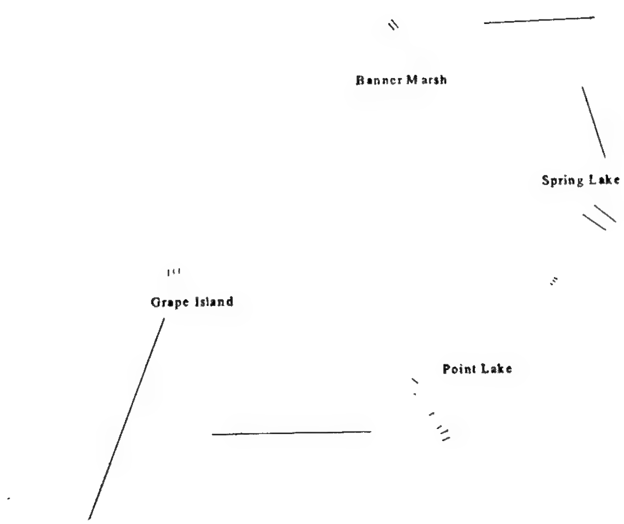

Figure 6. Location and arrangement of transects in La Grange Pool (Illinois

Methods

Transect Sampling

The transect sampling scheme was designed to investigate aquatic vegetation along imaginary straight lines that traverse a backwater (or location), typically from shoreline to shoreline. These lines are traditionally called transects. The arrangement of transects in each backwater was determined in the first year (mostly during 1991) the backwater was chosen for monitoring (Figures 2–6). The transects are usually parallel lines of equal distance 50–200 m apart. During sampling, a field crew drives a boat along each transect and stops at regular distances (Appendix A). Each stop is called a sampling site.

Aquatic vegetation was sampled once each in spring and summer. Spring sampling is usually between May 15 and June 15 and summer sampling is usually between July 15 and August 31 (Rogers and Owens 1995). Since 1996, water temperature was utilized to determine the onset of spring sampling in addition to the rule of calendar dates. Accordingly, spring sampling begins when water temperature in the backwaters reaches 18° C, at which temperature most submersed aquatic species have begun to grow and elongate (Barko and Smart 1981; Madsen and Adams 1988; Flint and Madsen 1995). Sampling should be initiated by May 22 regardless of temperature so it can be completed in time. In 1997, spring sampling was between May 21 and June 22 and summer sampling was between July 15 and August 25 for all field stations (Appendix A).

The method of sampling aquatic vegetation at each site was modified from a technique used by Jessen and Lound (1962). The sampling area was a 2-m circle immediately in front of the bow of the boat. It was divided into thirds from which plants were collected using a long-handled thatching rake. The rake was lowered to the bottom, twisted 180 degrees to snag vegetation, and then retrieved. The thatching rake had a 38-cm (15-inch) head with 20, 12.7-cm-long (5-inch) teeth. The area covered by the rake head during the twisting is approximately 0.1 m^2. Submersed plant species collected on the rake were identified and recorded. After all three segments of the circle were sampled, each species was assigned a rating of 1, 2, or 3 corresponding to the number of times the species was retrieved in the three rake samples. A rating of 4 was assigned if a species completely covered the rake teeth on all three twists. Beginning in 1997, a rating of "9" was given to species observed in the sampling area but not retrieved in any of the three rake samples. In previous years, such species were not recorded as legitimate entries. Water depth at each site was measured to the nearest decimeter using the handle of the rake, which is scaled and marked. Residual sediment retrieved on the rake during vegetation sampling was classified into one of three categories based on visual and tactile characteristics. These categories include silt and/or clay, mostly silt with some sand, and mostly sand with some silt. Sediment types were recorded for individual transects rather than for individual sites.

If a rooted floating-leaved species was present, it was assigned a rating of 1 to 4 based on the amount of vegetative cover visible in the entire 2 m sampling area (1 = 1–25% cover, 2 = 26–50% cover, 3 = 51–75% cover, and 4 = 76–100% cover). A nonrooted floating species (e.g., Lemnaceae) was recorded only if it exceeded 5% of the surface area, but was excluded from analysis.

Fassett (1957), Voss (1972, 1985) and Gleason and Cronquist (1991) were the primary keys used for plant identification. Scientific nomenclature and common names are based on those found in the U.S. Department of Agriculture PLANTS Database on the Internet (http://plants.usda.gov/plants/). Leafy pondweed (*Potamogeton foliosus*) and small pondweed (*P. pusillus*) were usually not identified to species during field sampling and were recorded in a code "NLPW" for "small or leafy pondweeds." In some instances they were identified to species, then the record with the higher rating at the site was kept and renamed as "NLPW" in analysis. Eurasian watermilfoil (*Myriophyllum spicatum*) includes specimens that were identified to species as well as specimens recorded as *Myriophyllum* spp.

Since 1991, voucher specimens were collected and stored at each field station. Rare species and unusual specimens were sent to outside experts for verification.

Informal Survey

To gain perspective on the distribution and composition of submersed aquatic vegetation in habitats other than transect locations, additional areas within each study pool were surveyed qualitatively during the break between the spring and summer sampling. When a sizable vegetation bed was observed, data on species composition, relative abundance, approximate bed size, water depth, substrate type, and location were recorded. Informal surveys have not been conducted in Pool 26 since 1992 when extensive surveys revealed that submersed aquatic vegetation was generally scarce. Informal survey data were not summarized in this report, but relevant information is stated wherever appropriate.

Data Summary

The frequency of a species is the number of sites in which the species were found, divided by the total number of the sites surveyed in the backwater, multiplied by 100 (percent). The frequencies of submersed or floating-leaved vegetation were similarly calculated. The frequency of a species in any year was the higher value of the spring and summer frequencies. This treatment was based on considerations of the seasonality and the opportunistic nature of aquatic plant species in a river environment. The frequency data of 1997 were compared with frequency data of 1996 to determine whether an increase or decrease was statistically significant. Based on the assumption that the frequency of species in a backwater in any year is an independent variable that has a binomial distribution, a 95% confidence interval for the true difference between 1996 and 1997 was computed according to the following formula (Walpole and Myers 1978):

$$(p_1-p_2)-1.96\sqrt{\frac{p_1q_1}{n_1}+\frac{p_2q_2}{n_2}}<(P_1-P_2)<(p_1-p_2)+1.96\sqrt{\frac{p_1q_1}{n_1}+\frac{p_2q_2}{n_2}}$$

where p_1 and p_2 are the frequencies of presence of a species in 1996 and 1997, respectively; n_1 and n_2 are the total number of sites sampled of 1996 and 1997, respectively; P_1 and P_2 are the unknown "true" frequencies of presence of the species in 1996 and 1997, respectively; and $q_1 = 100 - p_1$ and $q_2 = 100 - p_2$. If the interval contains the value zero, then the frequency of 1997 is concluded to be statistically the same as the frequency of 1996. Otherwise, we noted whether the 1997 frequency was an increase or decrease from the previous year. Also, we noted when a species was found for the first time in a backwater, when a species was present the previous year and not found in 1997, and when a species reappeared after a disappearance of one or more years. The frequency of a species was compared with available data for the period 1991–96 and noted whether it was the high or low for that period. Details for the individual pools are given in Results and Discussion following.

Results and Discussion

Pool 4

Based on data from the nine backwaters, we concluded that Pool 4 aquatic vegetation had a moderately good growing season in 1997 (Figure 7; Table 1). Compared with 1996, the frequency of submersed and rooted floating-leaved aquatic vegetation increased in Upper Peterson Lake, Rice Lake–Big Lake Bay, Robinson Lake, and Mud Lake; decreased in Catherine's Pass; and remained statistically the same in Lower Peterson Lake, Big Lake, Goose Lake, and Dead Slough Lake. Backwaters upstream of Lake Pepin, where sago pondweed (*Potamogeton pectinatus*) constituted the majority of the submersed aquatic vegetation, have been poor in species diversity for many years. In contrast, backwaters downstream of Lake Pepin historically have supported many more species. After a steady pool-wide decline from 1990, aquatic vegetation in the backwaters below Lake Pepin seemed to be rebounding in 1997. The nine backwaters surveyed, however, were still at or near all-time lows since 1991.

Wild celery (*Vallisneria americana*) was the most frequently encountered (MFE) species in Lower Peterson Lake. In Upper Peterson Lake, coontail (*Ceratophyllum demersum*) and sago pondweed increased significantly in 1997 and, with wild celery, became one of the MFE species in this backwater. No one species was frequently encountered in Big Lake. In Rice Lake–Big Lake Bay, Eurasian watermilfoil has been the MFE species and was increasing rapidly over the previous 2 years. The frequency of American lotus (*Nelumbo lutea*) in Rice Lake–Big Lake Bay reached a high but was statistically the same as in 1996. In Robinson Lake, American white waterlily (*Nymphaea odorata*) remained an MFE species, whereas coontail and wild celery expanded rapidly in 1997 and became two MFE species.

Coontail was found for the first time in Mud Lake in 1997. Eurasian watermilfoil, northern watermilfoil (*M. sibiricum*), wild celery, American lotus, and American white waterlily reached a high (1991–97) in one or more backwaters. Many species reappeared in backwaters downstream of Lake Pepin. The species that reappeared are all

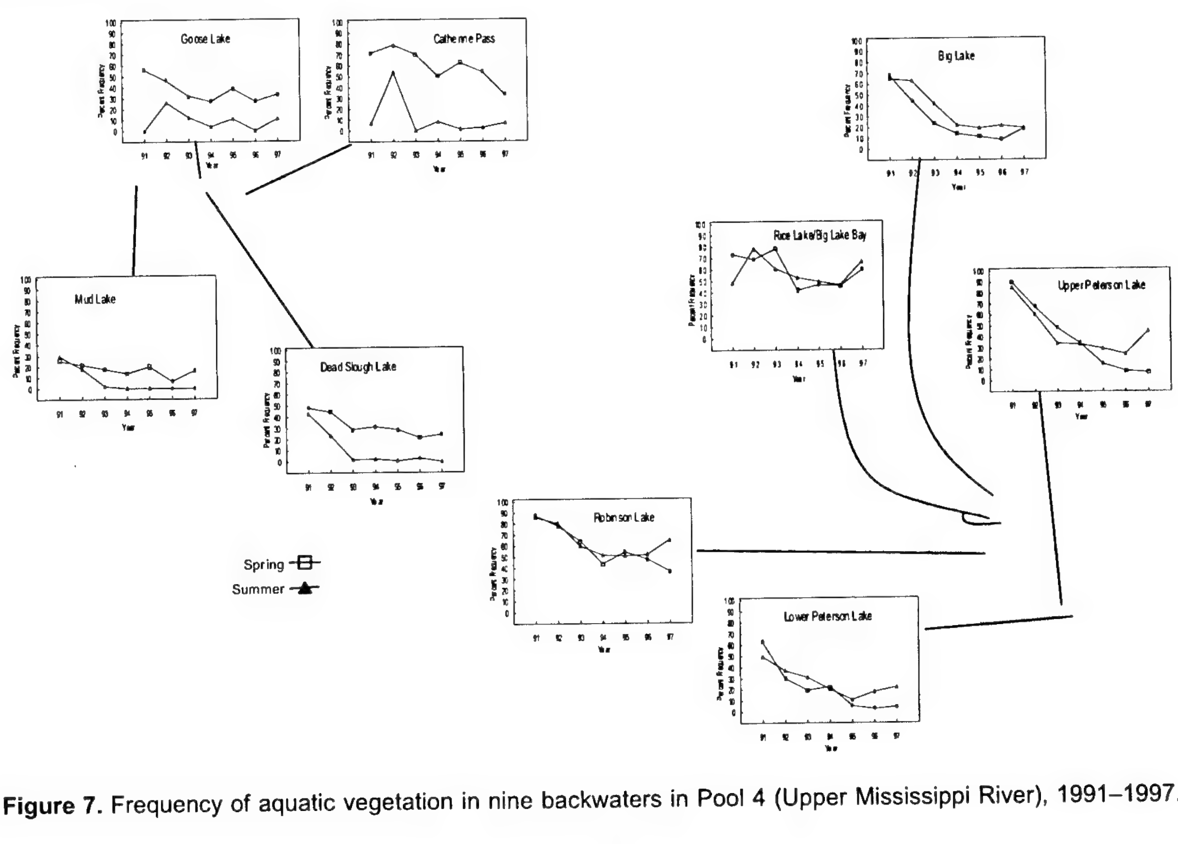

Figure 7. Frequency of aquatic vegetation in nine backwaters in Pool 4 (Upper Mississippi River), 1991–1997.

Table 1. Percent frequency of aquatic plant species by backwater or location in Pool 4, Mississippi River, during spring (Sp, May 28–June 13) and summer (Su, July 28–August 25) sampling periods, 1997.

Species		Lower Peterson Lake		Upper Peterson Lake		Big Lake		Rice Lake-Big Lake Bay		Robinson Lake		Catherine Pass[a]		Goose Lake[a]		Dead Slough Lake[a]		Mud Lake[a]	
		Sp	Su	Sp	Su	Sp	Su	Sp	Su	Sp	Su	Sp	Su	Sp	Su	Sp	Su	Sp	Su
	n	127	118	80	80	167	148	91	78	220	205	88	88	30	28	142	143	57	55
Submersed species																			
coontail	(*Ceratophyllum demersum*)	0.8	1.7	-	16.3[b]	1.2	1.4	3.3	9.0	5.9	22.9[b]	-	-	-	-	-	-	1.8[c]	-
horned pondweed	(*Zannichellia palustris*)	-	-	-	2.5[d]	-	-	-	-	0.5[d]	-	-	-	-	-	-	-	-	-
pondweed, curly	(*Potamogeton crispus*)	2.4[e]	0.8	3.8	3.8	6.6	0.7	7.7[e,f]	1.3	10.9[e,f]	8.8	-	-	-	-	-	-	-	-
pondweed, flatstem	(*P. zosteriformis*)	-	-	-	-	-	-	-	-	0.5	0.5	-	-	-	-	-	-	-	-
pondweed, longleaf	(*P. nodosus*)	-	-	-	-	0.6[d]	-	1.1	1.3	-	1.0	-	-	-	-	-	-	-	-
pondweed, sago	(*P. pectinatus*)	0.8	3.4	2.5	22.5[b]	1.2	1.4[e]	5.5[e,f]	2.6	13.6	15.6[e]	33.0[e,f]	6.8	33.3	10.7	23.9	-	14.0	-
pondweeds, small or leafy	(*P. foliosus, P. pusillus*)	-	-	-	3.8[d]	-	-	-	2.6	0.5	3.4	-	-	-	-	-	-	-	-
water stargrass	(*Heteranthera dubia*)	-	1.7[d]	-	7.5	-	0.7[d]	-	-	1.4	10.2[b]	-	-	-	-	-	-	-	-
watermilfoil, Eurasian	(*Myriophyllum spicatum*)	0.8	1.7	1.3	6.3	5.4[b]	2.0	29.7[b,g]	29.5	10.0	10.2	-	-	-	-	-	-	-	-
watermilfoil, northern	(*M. sibiricum*)	-	-	-	-	-	-	2.2	-	0.5[d]	1.5[b,g]	-	-	-	-	-	-	-	-
waternymph, nodding	(*Najas flexilis*)	-	-	-	1.3[d]	-	-	-	-	-	1.0[d]	-	-	-	-	-	-	-	-
waterweed, Canadian	(*Elodea canadensis*)	-	1.7[d]	-	11.3[b]	-	1.4[d]	2.2[d]	6.4[b]	5.9	13.2[b]	-	-	-	-	-	-	-	-
wild celery	(*Vallisneria americana*)	-	17.8[b]	-	18.8	-	8.8[e]	-	7.7[g]	-	32.7[b]	-	-	-	-	-	-	-	-
Rooted floating-leaved species																			
lotus, American	(*Nelumbo lutea*)	-	-	-	-	2.4	9.5	13.2	35.9[g]	-	1.0[g]	-	-	-	-	-	-	-	-
waterlily, American white	(*Nymphaea odorata*)	-	0.8	-	2.5[d,g]	6.0[b,d]	0.7	15.4[e]	9.0	13.2	26.3	-	-	-	-	-	-	-	-
Algae																			
filamentous algae	(Chlorophycaea)	-	-	-	-	-	-	-	-	-	-[f,h]	-	-	-	-	-	-	-	-
Frequency of submersed vegetated sites		4.7	21.2	7.5	46.3[b]	13.2[e]	11.5	42.9	42.3	33.6	56.1[b]	33.0[e,f]	6.8	33.3	10.7	23.9	-	15.8[b]	-
Frequency of rooted floating-leaved vegetated sites		-	0.8	-	2.5[d,g]	7.8	10.1	27.5	38.5	13.2	26.8	-	-	-	-	-	-	-	-
Frequency of submersed and rooted floating-leaved sites		4.7	22.0	7.5	46.3[b]	18.6	18.9[e]	59.3	66.7[b]	36.8	64.9[b]	33.0[e,f]	6.8	33.3	10.7	23.9	-	15.8[b]	-

[a]Located upstream of Lake Pepin.
[b]Significant increase from 1996.
[c]First record.
[d]Reappeared after absence in 1996.
[e]Lowest record of 1991–1997.
[f]Significant decrease from 1996.
[g]Highest record of 1991–1997.
[h]Disappeared between 1996 and 1997.

infrequent, and their reappearances did not indicate a statistically significant increase in percent frequencies of these species. Exceptions include American white waterlily in Big Lake, Canadian waterweed (*Elodea canadensis*) in Rice Lake–Big Lake Bay, and northern watermilfoil in Robinson Lake. Wild celery, an important wildlife food source, increased in Robinson Lake and Lower Peterson Lake. Canadian waterweed increased in three backwaters and coontail in two.

In 1997, 13 submersed and 2 rooted floating-leaved aquatic species were sampled in the 9 backwaters. Of these, nodding waternymph (*Najas flexilis*) and wild celery were unique to the summer sampling. The only species common to all nine backwaters was sago pondweed. Robinson Lake, where all 15 species were found, had the highest species richness. Six additional species—common bladderwort (*Utricularia macrorhiza*), longbeak buttercup (*Ranunculus longirostris*), chara (*Chara* spp.), alpine pondweed (*P. alpinus*), ribbonleaf pondweed (*P. epihydrus*), and Richardson's pondweed (*P. richardsonii*)—were found during the informal survey.

Pool 8

According to data from the eight backwaters, Pool 8 aquatic vegetation grew well in 1997 (Figure 8; Table 2). All eight backwaters had greater than 55% of the sites supporting aquatic vegetation. In the Stoddard backwater, Boomerang Island, Horseshoe Island, Shady Maple, and Goose Island backwater, the frequency of submersed and rooted floating-leaved aquatic vegetation increased significantly from 1996, whereas it decreased significantly in Lawrence Lake. Submersed species reached a high in Boomerang Island and the Goose Island backwater, whereas rooted floating-leaved plants reached highs in Boomerang Island, Shady Maple, and Blue Lake. Five of eight backwaters had four or more species whose frequency reached highs in 1997. Although many species disappeared or reappeared in one or more backwaters, most of these species were infrequent; therefore, the disappearance and reappearance was the result of chance. The exceptions are the reappearance of Canadian waterweed and small or leafy pondweeds in Shady Maple and coontail and Eurasian watermilfoil in Horseshoe Island, as well as the disappearance of horned pondweed (*Zannichellia palustris*) in Horseshoe Island. Goose Island showed the greatest change in submersed and rooted floating-leaved plants with the disappearance of two species, the highest record of seven species, and the reappearance of two species. Five species increased from 1996, whereas two species decreased. The trend since 1991 has been an increase in the frequency of submersed and rooted floating-leaved vegetation in the eight backwaters, which seem to be at or near the best condition recorded since 1991.

Fourteen submersed and three rooted floating-leaved plant species were found in transect sampling in 1997. Two additional species, Richardson's pondweed and northern watermilfoil, were found during the informal survey. Coontail, curly pondweed (*P. crispus*), small or leafy pondweeds, sago pondweed, and Canadian waterweed were present in all eight backwaters. Horned pondweed and longbeak buttercup were unique to spring sampling, whereas water stargrass (*Heteranthera dubia*) and wild celery were found only during summer sampling. Flatstem pondweed (*Potamogeton zosteriformis*) was found for the first time in the Stoddard backwater and Shady Maple, and horned pondweed was found for the first time in Blue Lake. Horned pondweed disappeared from three backwaters, whereas flatstem pondweed and water stargrass each disappeared from two. The highest species richness was found in Lawrence Lake (16 aquatic species).

Curly pondweed increased in the Stoddard backwater in 1997 and became an MFE species in the backwater, together with coontail and Canadian waterweed. Coontail and American white waterlily, followed by small or leafy pondweeds were MFE species in Blue Lake. Both backwaters are isolated from the main channel of the Mississippi River. In Horseshoe Island and Boomerang Island, both located in the impounded area of Pool 8 and open to southern winds, sago pondweed and American lotus were the MFE species. Coontail and Canadian waterweed showed a significant increase in Shady

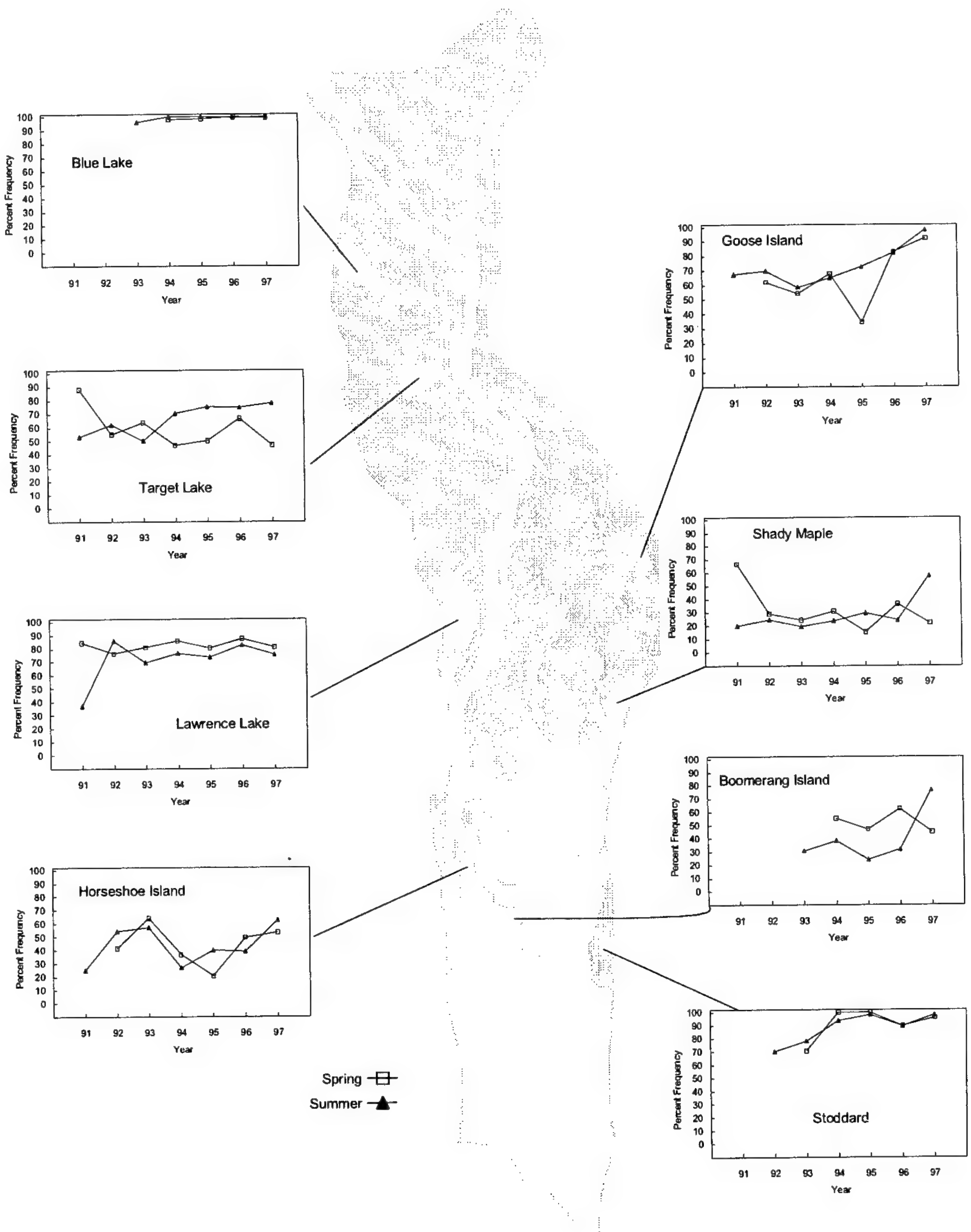

Figure 8. Frequency of aquatic vegetation in eight backwaters in Pool 8 (Upper Mississippi River), 1991–1997.

Maple, surpassed sago pondweed, and became the MFE species in the backwater. Although coontail and American white waterlily decreased in Lawrence Lake, they were still the MFE species. Eurasian watermilfoil and coontail increased in the Goose Island backwater, present in greater than 80% of the sites. Sago pondweed and coontail were the MFE species in Target Lake.

Pool 13

Based on data from the seven backwaters, we concluded Pool 13 aquatic vegetation had a good growing season in 1997 (Figure 9; Table 3). In terms of frequency of submersed and rooted floating-leaved vegetation, Johnson Creek has maintained the highest value possible (100%) since 1993; Johnson Creek Levee, Potter's Marsh, and Brown's

Table 2. Percent frequency of aquatic plant species by backwater or location in Pool 8, Mississippi River, during spring (Sp, May 22–June 12) and summer (Su, July 15–August 14) sampling periods, 1997.

		Stoddard		Boomerang Island		Horseshoe Island		Shady Maple		Lawrence Lake		Goose Island		Target Lake		Blue Lake	
		Sp	Su	Sp	Su	Sp	Su	Sp	Su	Sp	Su	Sp	Su	Sp	Su	Sp	Su
Species	*n*	50	51	104	104	90	85	107	102	426	402	119	114	287	286	126	116
Submersed species																	
bladderwort, common	(*Utricularia macrorhiza*)	-	-	-	-	-	-	-	-	7.5[a,b]	2.7	-	-	0.7[c]	-	4.0	4.3[c]
buttercup, longbeak	(*Ranunculus longirostris*)	-	-	-	-	-	-	-	-	0.2[d]	-	-	-	-	-	-	-
coontail	(*Ceratophyllum demersum*)	78.0	90.2	-	1.9[d]	-	3.5[a,b,d]	3.7	38.2[a,b]	56.1	67.4[c]	71.4	86.0[a,b]	23.3	40.2	90.5	93.1
pondweed, horned	(*Zannichellia palustris*)	-	-	1.0[a,d]	-	-	-[c,e]	-	-	-	-[e]	-	-[e]	-	-	0.8[f]	-
pondweed, curly	(*Potamogeton crispus*)	46.0	51.0[b]	6.7	20.2[a]	4.4	9.4[a]	0.9	12.7	27.7	10.9	17.6	18.4[a,b]	0.7	5.2[b]	19.0[c]	7.8
pondweed, flatstem	(*P. zosteriformis*)	2.0[f]	-	-	-	-	-	-	4.9[b,f]	10.6[a]	5.5	33.6	40.4[a,b]	-	-[e]	-	-[e]
pondweed, longleaf	(*P. nodosus*)	-	-	-	1.0[f]	-	-	-	2.9[a]	0.9	0.7	2.5	1.8	0.3	2.1	-	-
pondweed, sago	(*P. pectinatus*)	20.0	39.2	41.3	50.0	33.3	34.1	8.4	17.6	26.8[c]	16.9	7.6[c]	1.8	26.5	48.3	1.6	14.7
pondweeds, small or leafy	(*P. foliosus, P. pusillus*)	12.0	7.8	-	2.9[a]	6.7	9.4[a]	-	14.7[a,b,d]	23.0[a]	14.7	12.6	14.0[a]	10.8	19.9[a,b]	70.6[c]	51.7
water stargrass	(*Heteranthera dubia*)	-	-	-	1.0[d]	-	-	-	2.0[a,d]	-	3.7[a]	-	-[e]	-	-[e]	-	-
watermilfoil, Eurasian	(*Myriophyllum spicatum*)	-	-	-	1.0[d]	3.3[d]	10.6[b]	7.5	10.8	30.3	30.8	81.5	93.9[a,b]	1.0	3.5[b]	-	-
waternymph, nodding	(*Najas flexilis*)	-	-	-	-	-	2.4[d]	-	-	0.2	5.0[c]	-	1.8[d]	-	0.3	-	20.7[a]
waterweed, Canadian	(*Elodea canadensis*)	42.0	54.9	-	6.7[b,f]	-	9.4[a]	1.9[d]	23.5[a,b]	3.3	6.2[b]	32.8	56.1[a,b]	1.4	4.9[b]	-	0.9[c]
wild celery	(*Vallisneria americana*)	-	-	-	1.9	-	2.4[f]	-	1.0[d]	-	0.2	-	-	-	-	-	-
Rooted floating-leaved species																	
lotus, American	(*Nelumbo lutea*)	-	-	-	36.5[a,b]	14.4	31.8	-	12.7[a]	4.0	15.4[a]	-	21.9[c]	-	34.3	-	3.4[a]
pond-lily, yellow	(*Nuphar variegata*)	-	-	-	-	-	-	-	-	8.5	10.9[c]	-	1.8[a,d]	-	-	0.8	1.7
waterlily, American white	(*Nymphaea odorata*)	18.0	27.5[c,g]	-	-	-	1.2[c,g]	0.9	-	42.7	48.8[c]	34.5	42.1	16.7	32.9	73.0	90.5
Algae																	
filamentous algae	(Chlorophycaea)	58.0	33.3	-	18.3[a]	-	3.5[c]	-	2.9	33.3	17.7	13.4	30.7[c]	1.0[c]	-	0.8[c]	-
Frequency of submersed vegetated sites		96.0	98.0[b]	45.2	66.3[a]	44.4	47.1	21.5	53.9[b]	78.2[c]	73.1	92.4	96.5[a,b]	45.3	73.4	97.6	94.8
Frequency of rooted floating-leaved vegetated sites		18.0	27.5[c,g]	-	36.5[a,b]	14.4	32.9	0.9	12.7[a]	47.7	57.5	34.5	58.8[c]	16.7	52.1	73.0	93.1[a]
Frequency of submersed and rooted floating-leaved sites		96.0	98.0[b]	45.2	76.9[a,b]	53.3	62.4[b]	22.4	57.8[b]	81.2[c]	75.4	92.4	98.2[a,b]	47.0	78.0	99.2	100.0

[a]Highest record of 1991–1997.
[b]Significant increase from 1996.
[c]Significant decrease from 1996.
[d]Reappeared after absence in 1996.
[e]Disappeared between 1996 and 1997
[f]First record.
[g]Lowest record of 1991–1997.

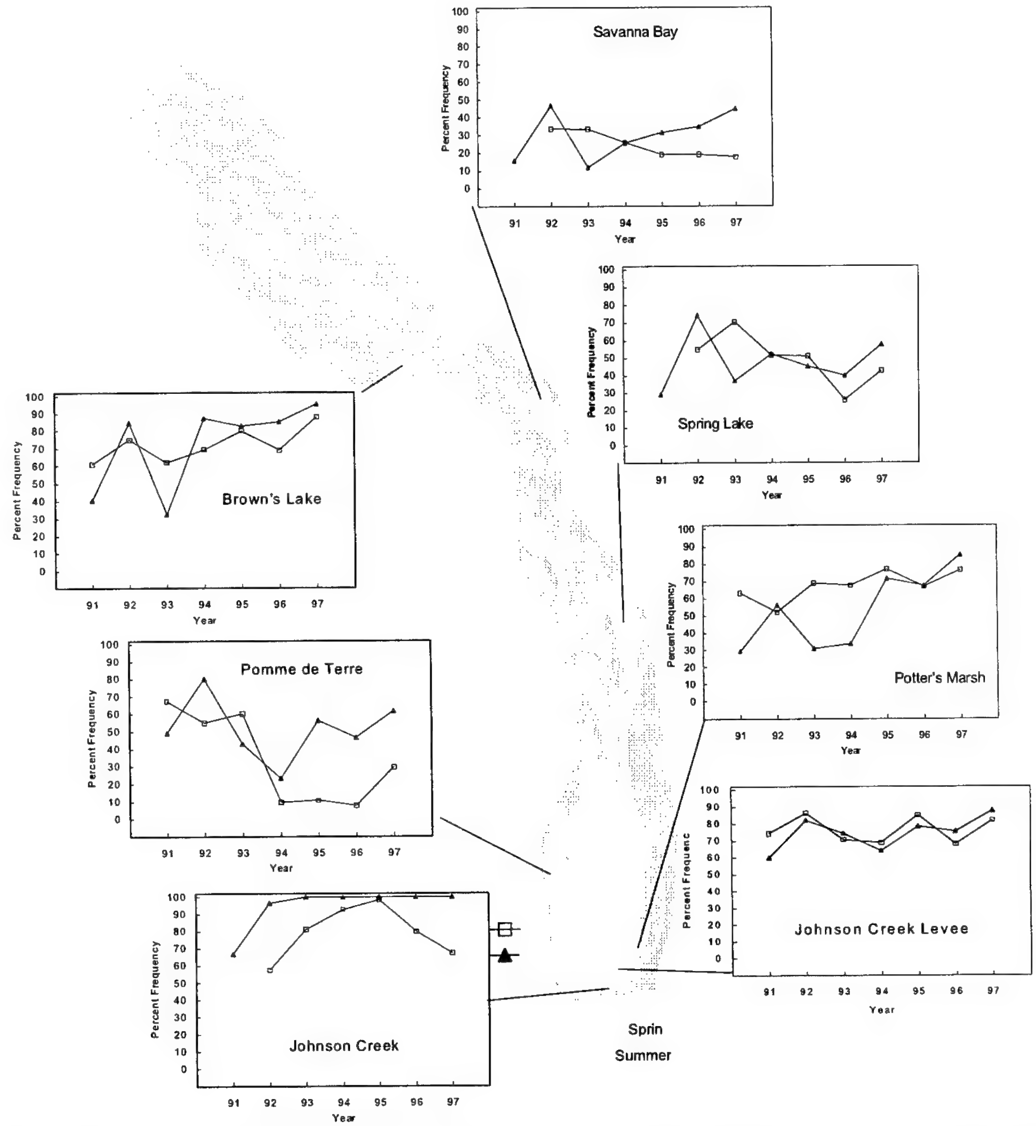

Figure 9. Frequency of aquatic vegetation in seven backwaters in Pool 13 (Upper Mississippi River), 1991–1997.

Lake reached highs in 1997 (greater than 85%); and Pomme de Terre, Spring Lake, and Savanna Bay all increased significantly with respect to the 1996 levels. Eleven species reached highs in one or more backwaters, and three—water stargrass, American lotus, and southern waternymph (*Najas guadalupensis*)—reached highs in three or more backwaters. Horned pondweed and nodding waternymph were sampled for the first time in Johnson Creek and Potter's Marsh, respectively. Many species reappeared in one or more backwaters. All these species were infrequent and most of the disappearance or reappearance events were the result of chance. However, the reappearances of chara in Johnson Creek Levee, American lotus in Potter's Marsh, and curly pondweed in Pomme de Terre resulted from a statistically significant increase in percent frequencies of the three species. Likewise, the disappearance of flatstem pondweed and algae in Savanna Bay and algae in Spring Lake were because of a significant decrease in percent frequencies. Wild celery seemed to be prosperous in the lower impounded areas such as Johnson Creek, Johnson Creek Levee, and Potter's Marsh; except in Pomme de Terre where its frequency remained statistically the same as in 1996. Eurasian watermilfoil also seemed to be prosperous, its frequency increasing in Johnson Creek Levee, Potter's Marsh, Pomme de Terre, and Spring Lake.

Table 3. Percent frequency of aquatic plant species by backwater or location in Pool 13, Mississippi River, during spring (Sp, May 21–June 13) and summer (Su, July 18–August 18) sampling periods, 1997.

Species		Johnson Creek		Johnson Creek Levee		Potter's Marsh		Pomme de Terre		Spring Lake		Savanna Bay		Brown's Lake	
		Sp	Su	Sp	Su	Sp	Su	Sp	Su	Sp	Su	Sp	Su	Sp	Su
	n	61	65	123	122	101	129	71	81	174	181	143	141	384	421
Submersed species															
coontail	(*Ceratophyllum demersum*)	34.4	80.0[a]	7.3	14.8	-	1.6[b]	11.3	27.2[c]	4.6	14.9[c]	6.3	11.3	44.8	59.1[c,d]
horned pondweed	(*Zannichellia palustris*)	-	6.2[c,e]	-	-	-	-	-	-	-	-	-	-	-	-
pondweed, curly	(*Potamogeton crispus*)	1.6	9.2	1.6	-	1.0	-	-	6.2[b,c]	1.1	5.5	-	0.7	3.4[c]	0.5
pondweed, flatstem	(*P. zosteriformis*)	3.3[a]	-	2.4	-	-	-	-	-	-	-	-	-[a,f]	-	-
pondweed, longleaf	(*P. nodosus*)	3.3	13.8[d]	1.6	4.9[c]	1.0	1.6	1.4	-	2.3	7.2[c]	-	-[f]	3.4	4.5[c]
pondweed, sago	(*P. pectinatus*)	16.4	35.4	42.3[g]	9.8	53.5	15.5	11.3	12.3	35.1	43.1[c]	14.0	8.5	59.9	40.4
pondweeds, small or leafy	(*P. foliosus, P. pusillus*)	-	1.5	-	-	-	-	-	-	-	0.6	-	-	-	1.9[c,d]
water stargrass	(*Heteranthera dubia*)	-	35.4[a]	26.0	74.6[c,d]	12.9	76.0[c,d]	-	30.9[d]	-	4.4[d]	-	4.3	-	-
watermilfoil, Eurasian	(*Myriophyllum spicatum*)	16.4	24.6	38.2	57.4[c,d]	13.9	36.4[c,d]	14.1	33.3[c]	-	6.6[c]	-	-	-	-
waternymph, nodding	(*Najas flexilis*)	-	16.9	-	11.5[c,d]	-	4.7[c,e]	-	1.2[b]	-	6.6	-	-[f]	-	-
waternymph, southern	(*N. guadalupensis*)	-	13.8	-	6.6[d]	-	2.3[bd]	-	4.9[d]	-	2.2	-	-	-	-[f]
waterweed, Canadian	(*Elodea canadensis*)	14.8	12.3[a]	-	7.4[c]	-	-	4.2	12.3[c]	-	1.1[bd]	-	-	-	-
wild celery	(*Vallisneria americana*)	-	80.0	61.0	75.4[c,d]	26.7	51.9[c,d]	1.4	23.5	-	0.6	-	-	-	-
Rooted floating-leaved species															
American lotus	(*Nelumbo lutea*)	-	89.2[c,d]	9.8	16.4	2.0[b]	4.7[c]	-	2.5	9.8	28.7[c]	0.7	40.4[c,d]	78.9	95.5[c,d]
waterlily, white	(*Nymphaea odorata*)	26.2	43.1	7.3	9.0	-	-	-	4.9[d]	4.6	5.5	-	-	0.3	0.2
Algae															
chara	(*Chara* spp.)	-	-[f]	-	4.1[b,c,d]	-	-	-	-	-	-	-	-	-	-
filamentous algae	(Chlorophycaea)	4.9	13.8[a]	8.9	45.1[c]	55.4	68.2[c,d]	9.9	21.0[c]	-	-[a,f]	-	-[a,f]	-	1.7[a]
nitella	(*Nitella* spp.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-[f]
Frequency of submersed vegetated sites		52.5	100.0	82.1	87.7[c,d]	76.2	85.3[c,d]	29.6	61.7[c]	37.4	53.0[c]	17.5	18.4	72.7[c]	67.9
Frequency of rooted floating-leaved vegetated sites		26.2	98.5[c,d]	13.8	17.2	2.0[b]	4.7[c]	-	7.4	13.2	29.8[c]	0.7	40.4[c,d]	78.9	95.5[c,d]
Frequency of submersed and rooted floating-leaved sites		67.2	100.0	82.1	87.7[c,d]	76.2	85.3[c,d]	29.6	61.7[c]	42.5	57.5[c]	17.5	44.7[c]	88.0	95.5[c,d]

[a]Significant decrease from 1996.
[b]Reappeared after absence in 1996.
[c]Significant increase from 1996.
[d]Highest record of 1991–1997.
[e]First record.
[f]Disappeared between 1996 and 1997.
[g]Lowest record of 1991–1997.

Eurasian watermilfoil peaked in Johnson Creek in 1994 at 88.1% and dropped to 27.7% in 1996. Its 1997 frequency (25%) was significantly the same as its 1996 frequency. The trend since 1991 has been an increase in the frequency of submersed and rooted floating-leaved vegetation in the seven backwaters. The 1997 frequencies were at or near the best recorded since 1991.

Many other changes in individual backwaters are noteworthy. Johnson Creek had much less water stargrass (35% in 1997 and 80% in 1996) and more American lotus (89% in 1997 and 68% in 1996); American lotus, coontail, and wild celery were the three MFE species in 1997. In Johnson Creek Levee, wild celery and water stargrass continued to be the MFE species, though Eurasian watermilfoil increased notably. Six species, including water stargrass, Eurasian watermilfoil, nodding waternymph, southern waternymph, wild celery, and chara reached highs in Johnson Creek Levee during the same growing season in 1997. In Potter's Marsh, wild celery became an MFE species, joining water stargrass and sago pondweed; and Eurasian watermilfoil increased notably. In Pomme de Terre, coontail and wild celery became MFE species, joining Eurasian watermilfoil and water stargrass. American lotus became an MFE species in Spring Lake, joining sago pondweed. American lotus remained to be an MFE species in Savanna Bay and Brown's Lake. Also noteworthy was that coontail doubled its frequency in 1997 from its 1996 level in Brown's Lake.

Sixteen species (submersed, rooted floating-leaved, and macro algae combined) were found in the seven backwaters in 1997. Flatstem pondweed was unique to the spring sampling, whereas horned pondweed, small or leafy pondweeds, nodding and southern waternymphs, and chara were unique to the summer sampling. Coontail, curly pondweed, sago pondweed, and American lotus were the common species present in all seven backwaters. Johnson Creek has 15 of the 16 species, the highest species richness among the seven backwaters.

Pool 26

Aquatic vegetation was rare in Pool 26 in the 1990s. The four locations monitored represent the few places where sizable aquatic vegetation beds were found in Pool 26 when the transects were established in 1991 and 1992. In 1997, aquatic vegetation was found only in Stump Lake (Figure 10; Table 4). No aquatic vegetation was found in

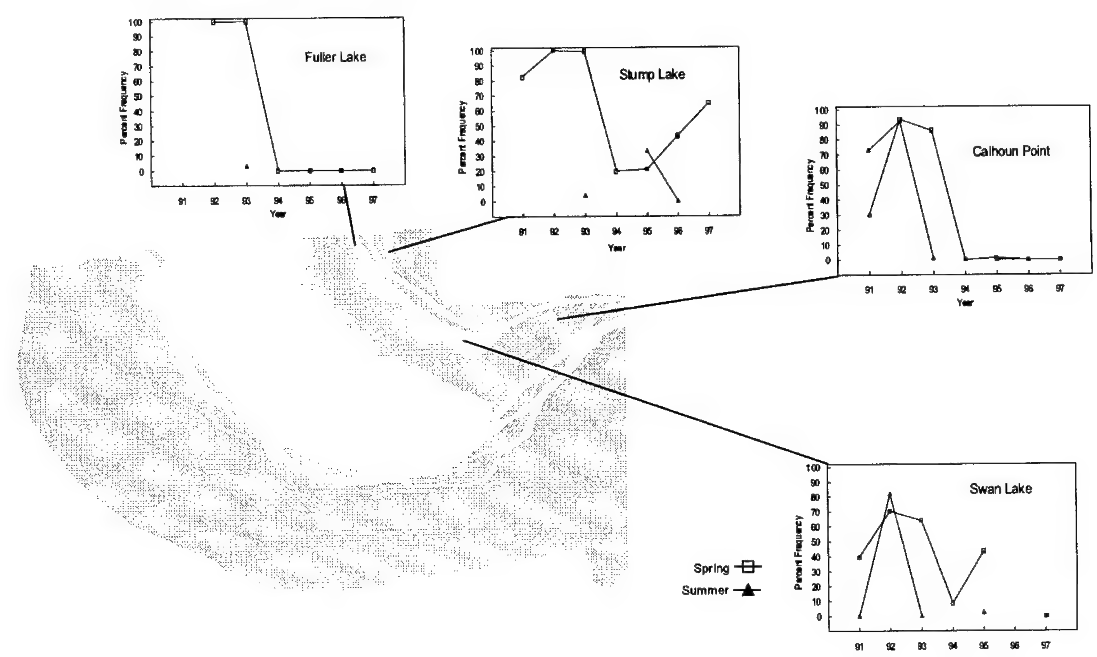

Figure 10. Frequency of aquatic vegetation in four backwaters in Pool 26 (Upper Mississippi and Illinois Rivers), 1991-1997.

Table 4. Percent frequency of aquatic plant species by backwater or location in Pool 26, Mississippi River, during spring (Sp, June 6–22) and summer (Su, August 7–11) sampling periods, 1997.

		Calhoun Point		Swan Lake		Stump Lake		Fuller Lake	
		Sp	Su	Sp	Su	Sp	Su	Sp	Su
Species	***n***	157	77	133	133	174	ns[a]	29	ns[a]
Submersed species									
coontail	(*Ceratophyllum demersum*)	-	-	-	-	1.7[b]		-	
pondweed, longleaf	(*Potamogeton nodosus*)	-	-	-	-	0.6[c]		-	
pondweed, sago	(*P. pectinatus*)	-	-	-	-	58.0[d]		-	
waterweed, Canadian	(*Elodea canadensis*)	-	-	-	-	3.4[b,d]		-	
Rooted floating-leaved species									
lotus, American	(*Nelumbo lutea*)	-	-	-	-	12.6		-	
pondlily, yellow	(*Nuphar variegata*)	-	-	-	-	0.6[e]		-	
Frequency of submersed vegetated sites		-	-	-	-	59.8[d]		-	
Frequency of rooted floating-leaved vegetated sites		-	-	-	-	13.2		-	
Frequency of submersed and rooted floating-leaved sites		-	-	-	-	64.9[d]		-	

[a]Not sampled.
[b]Reappeared after absence in 1996.
[c]Significant decrease from 1996.
[d]Significant increase from 1996.
[e]First appearance.

Calhoun Point, Swan Lake and Fuller Lake. All four backwaters had moderately high to high percentages of submersed aquatic vegetation between 1991 and 1993. High water levels lasted throughout the growing season of 1993 and little aquatic vegetation was found in the four backwaters in 1994. In 1996, aquatic vegetation disappeared completely from Calhoun Point and Fuller Lake (Swan Lake was not sampled because of access problems).

Stump Lake seems to have made a recovery following the destruction of the 1993 flood. The frequency of submersed and rooted floating-leaved aquatic vegetation has increased progressively from 1994. In 1997, sago pondweed was found at 58.0% of the sites. Coontail, one of the widespread species before the 1993 flood, reappeared in 1997 but its frequency (1.7%) was sharply lower than in 1993 (77%). Canadian waterweed and longleaf pondweed (*Potamogeton nodosus*) also has reappeared since the 1993 flood. Yellow pondlily (*Nuphar variegata*) was first found in Stump Lake in 1997. Sago pondweed, American lotus, Canadian waterweed, coontail, yellow pondlily, and longleaf pondweed were the six species found in 1997 in Stump Lake.

Stump Lake is isolated from the Illinois River except during extremely high floods. During our informal surveys, we found no aquatic vegetation in any of the contiguous backwaters in Pool 26.

La Grange Pool

As in Pool 26, aquatic vegetation has been rare in La Grange Pool in the 1990s. The four locations monitored represent the few places where sizable aquatic vegetation beds were found in La Grange Pool when the transects were established in 1991 and 1992. Aquatic vegetation was found in Spring Lake and Banner Marsh but not in Grape Island and Point Lake in 1997 (Figure 11; Table 5). Grape Island is a channel border area where sago pondweed was found in 1992–94 but has been void of aquatic vegetation since 1995. Point Lake is a semi-isolated backwater where several aquatic plant species, including coontail and sago pondweed, were found between 1991 and 1995. The lake had a small amount of coontail (9%) in 1996 and was completely void of aquatic vegetation in 1997. Spring Lake and Banner Marsh, two backwaters completely isolated from the main channel of the Illinois River, both had greater than 90% of sites containing aquatic vegetation. The frequency of submersed and rooted floating-leaved aquatic vegetation in 1997 was statistically the same as in 1996 in Banner Marsh, and higher than in 1996 in Spring Lake. No significant

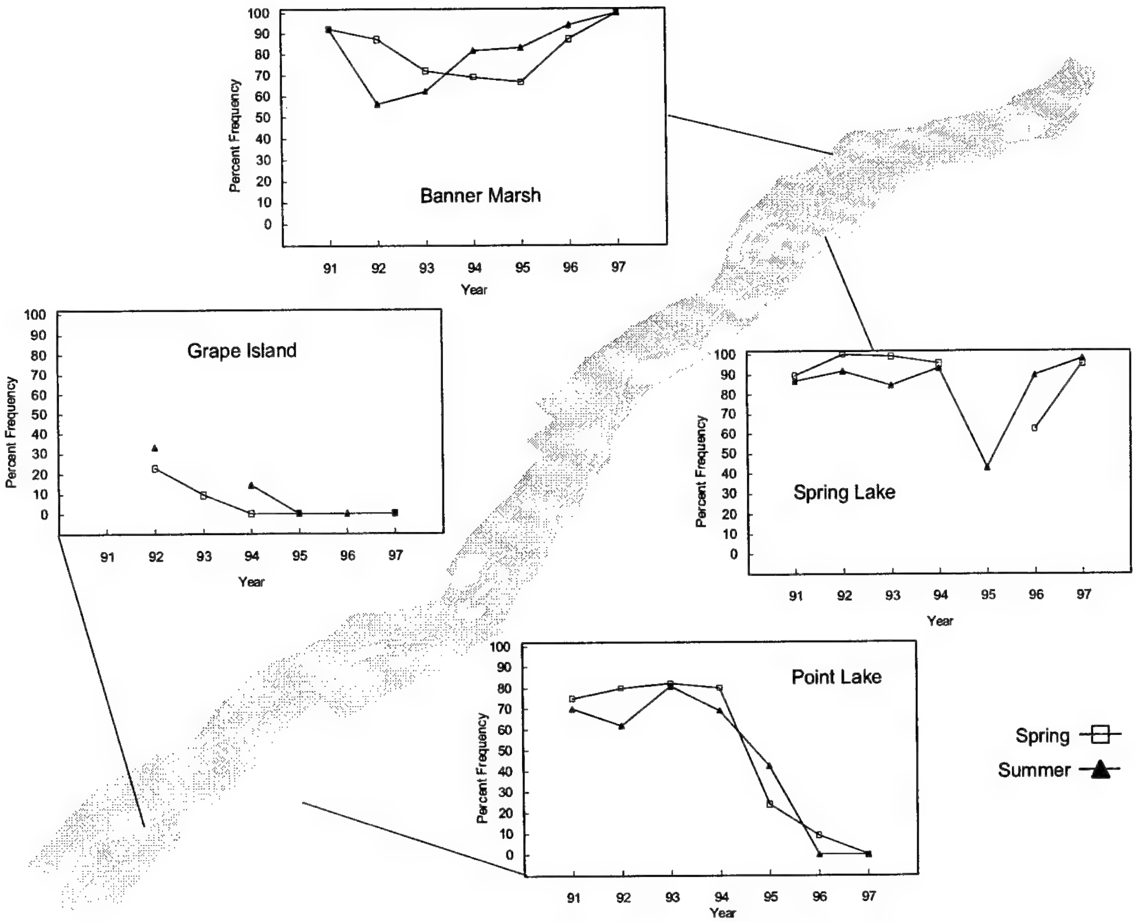

Figure 11. Frequency of aquatic vegetation in four backwaters in La Grange Pool (Illinois River), 1991-1997.

amount of aquatic vegetation was found in channel borders or contiguous backwaters in La Grange Pool during informal surveys; some small patches of sparse sago and horned pondweed were observed in September and October a few weeks after summer high water levels receded.

Spring Lake has had widespread Eurasian watermilfoil with a frequency greater than 80% since 1991, except in 1995 when it dropped to 32%. The sudden drop in 1995 may have been caused by an outbreak of aquatic milfoil weevil and an unusually high surface water temperature (>108° F) in summer of that year (Wayne Herndon, Illinois Department of Natural Resources, personal communication). Eurasian watermilfoil rebounded in the following seasons, however, and reached a high in 1997. Three other species, nodding waternymph, Canadian waterweed, and American lotus, also reached highs in 1997. Flatstem pondweed and water stargrass were found for the first time in Spring Lake; western waterweed reappeared; and longleaf pondweed disappeared in 1997. The reappearance of western waterweed was the result of chance.

In Banner Marsh, the frequency of coontail has increased since 1991 and reached a high (100%) in 1997. Eurasian watermilfoil was the second MFE species in this lake. Curly pondweed, longleaf pondweed, and small or leafy pondweeds disappeared in 1997.

Fifteen species of submersed and rooted floating-leaved aquatic plants and macro algae were found in Spring Lake and Banner Marsh in 1997. Spring Lake had all of the 15 species, whereas Banner Marsh had 3.

Table 5. Percent frequency of aquatic plant species by backwater or location in La Grange Pool, Illinois River, during spring (Sp, May 27–June 4) and summer (Su, July 16–July 24) sampling periods, 1997.

		Grape Island		Point Lake		Spring Lake		Banner Marsh	
		Sp	Su	Sp	Su	Sp	Su	Sp	Su
Species	***n***	16	16	24	25	119	99	14	12
Submersed species									
coontail	(*Ceratophyllum demersum*)	-	-	-	-[a]	9.2	10.1	100.0[b,c]	100.0
horned pondweed	(*Zannichellia palustris*)	-	-	-	-	10.1	3.0	-	-
pondweed, curly	(*Potamogeton crispus*)	-	-	-	-	30.3	7.1	-	-[a,d]
pondweed, flatstem	(*P. zosteriformis*)	-	-	-	-	-	12.1[c,e]	-	-
pondweed, longleaf	(*P. nodosus*)	-	-	-	-	-	-[a]	-	-[a,d]
pondweed, sago	(*P. pectinatus*)	-	-	-	-	1.7[d]	1.0	7.1	16.7
pondweeds, small or leafy	(*P. foliosus, P. pusillus*)	-	-	-	-	3.4	10.1[d]	-	-[a,d]
water stargrass	(*Heteranthera dubia*)	-	-	-	-	-	1.0[e]	-	-
watermilfoil, Eurasian	(*Myriophyllum spicatum*)	-	-	-	-	93.3[b,c]	83.8	42.9[d,f]	33.3
waternymph, brittle	(*Najas minor*)	-	-	-	-	-	1.0[d]	-	-
waternymph, nodding	(*N. flexilis*)	-	-	-	-	-	10.1[b]	-	-
waterweed, Canadian	(*Elodea canadensis*)	-	-	-	-	2.5	6.1[b]	-	-
waterweed, western	(*Elodea nutallii*)	-	-	-	-	-	1.0[g]	-	-
Rooted floating-leaved species									
lotus, American	(*Nelumbo lutea*)	-	-	-	-	7.6	13.1[b]	-	-
waterlily, white	(*Nymphaea odorata*)	-	-	-	-	0.8	4.0[d]	-	-
Algae									
chara	(*Chara* spp.)	-	-	-	-	8.4	13.1	-	-
filamentous algae	(Chlorophycaea)	-	-	-	-	16.0	50.5[c]	-	50.0
Frequency of submersed sites		-	-	-	-[a]	95.8	97.0[c]	100.0[b]	100.0
Frequency of rooted floating-leaved sites		-	-	-	-	8.4	16.2	-	-
Frequency of submersed and rooted floating-leaved sites		-	-	-	-[a]	95.8	98.0[c]	100.0[b]	100.0

[a]Disappeared between 1996 and 1997.
[b]Highest record of 1991–1997.
[c]Significant increase from 1996.
[d]Significant decrease from 1996.
[e]First record.
[f]Lowest record of 1991–1997.
[g]Reappeared after absence in 1996.

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Appendix A

Locations, Habitat, Number of Transects and Sites, Sampling Dates, and Distances Between Sites Sampled in Pools 4, 8, 13, and 26 of the Mississippi River and La Grange Pool of the Illinois River During the 1997 Sampling Season.

Location	Habitat[a]	Number of transects spring:summer	Number of sites spring	Number of sites summer	Sampling dates spring	Sampling dates summer	Distance between sites (m)
Pool 4							
Upper Mud Lake (M791.5)[b]	BWC	0:0	Not sampled[c]	Not sampled	Not sampled	Not sampled	30
Mud Lake (M791.3)	BWC	3:3	57	55	6/12B13	8/21	30
Dead Slough Lake (M789.2, M788.5, M788.0)	BWC	9:9	142	143	6/11B12	8/22, 25	30
Goose Lake (M788.G)[d]	BWC	3:3	30	28	6/12	8/22	30
Catherine Pass (Bay City Flats[e]; M787.0)	BWC	3:3	88	88	6/10	8/20	30
Robinson Lake (M758.R)[d]	BWC	9:9	220	205	6/2B3	8/5B7	30
Rice Lake/Big Lake Bay (M758.0, M758.5[f])	BWC	6:6	91	78	6/6, 9	8/13, 18	30
Big Lake (M757.5)	BWC	5:5	167	148	6/4B5	8/11, 18	30
Upper Peterson Lake (M754.8, M754.5)	BWC	6:6	80	80	5/28B30	7/28B29	30
Lower Peterson Lake (M753.5)	BWC	4:4	127	118	5/30, 2	7/29, 8/4	30
Total Pool 4		**48:48**	**1002**	**943**	**13**	**13**	
Pool 8							
Blue Lake (M697.0)	BWI	3:3	126	116	5/30	7/29B30	15
Target Lake (M696.0)	BWC	11:11	287	286	5/22B23, 27	7/15B16, 21	15
Goose Island (M692.0)	BWC	5:5	119	114	6/02	7/24B25	15
Lawrence Lake (M691.0	BWC	10:10	426	402	6/6, 9B12	8/1, 7B8, 11, 13B14	15
Shady Maple (M690.0)	BWC	3:3	107	102	6/3	8/4B5	15
Horseshoe Island (M687.0)[f]	BWC	5:5	90	85	6/5	8/4	15
Boomerang Island (M686.0)[f]	IMP	4:4	104	104	5/28	7/22	15
Stoddard (M684.0)	BWI	4:4	50	51	5/29	7/23	15
Total Pool 8		**45:45**	**1309**	**1260**	**14**	**17**	

Location	Habitat	Number of transects spring:summer	Number of sites spring	Number of sites summer	Sampling dates spring	Sampling dates summer	Distance between sites (m)
Pool 13							
Brown's Lake (M545.1, M544.5)[f]	BWC	20:20	384	421	6/5B6, 9B11	7/30B31 8/4B7	15
Savanna Bay (M541.5, M540.5, M539.5)	BWC	12:12	143	141	5/30	7/22, 24	15
Spring Lake (M534.8, M533.6, M532.0)	BWC	12:12	174	181	6/2B3	7/25, 28	15
Pomme de Terre (M526.0)	IMP	5:5	71	81	5/21	7/18	15
Potter's Marsh (M524.0)[f]	IMP	6:6	101	129	6/12	8/12B14	15
Johnson Creek Levee (M523.5)	IMP	4:4	123	122	6/13	8/14, 18	15
Johnson Creek (M523.0)	IMP	2:2	61	65	5/22	7/21	15
Total Pool 13		**61:61**	**1057**	**1140**	**12**	**16**	
Pool 26							
Calhoun Point (I003.0)[f]	BWI	18:9	157	77	6/6, 9	8/7	15
Swan Lake (I005.5)[f]	BWI	5:5	133	133	6/11, 13	8/8, 11	
Stump Lake (I010.0)[f]	BWI	8:0	174	Not sampled[h]	6/9B11, 22	Not sampled	15
Guller Lake (I011.5)	BWI	2:0	29	Not sampled[h]	6/10	Not sampled	15
Total Pool 26		**33:14**	**493**	**210**	**6**	**3**	
LaGrange Pool							
Grape Island (I086.4)	MCB	3:3	16	16	6/4	7/24	15
Point Lake (I100.0)	BWI	6:6	24	25	5/27	7/16	15
Spring Lake (I135.5)	BWI	5:6	119	99	5/28B30	7/21B23	15
Banner Marsh (Bulrush Pond[e]; I140.0)[f]	BWI	2:2	14	12	6/3	7/18	15
Total La Grange Pool		**16:17**	**173**	**152**	**7**	**6**	

[a]Type of habitats: BWC = Backwater contiguous, BWI = Backwater isolated, IMP=Impounded.
[b]Mississippi River miles, measured from the confluence of the Mississippi and Ohio Rivers.
[c]Transect location was discontinued because access as well as sampling became excessively difficult.
[d]AG≡and AR≡to distinguish this lake from another lake with the same river mile.
[e]Name used in reports previous to 1995.
[f]Part of a Habitat Rehabilitation and Enhancement Project.
[g]Pool 26 is located at the confluence of the Illinois and Mississippi Rivers and the portions named here extend up the Illinois River, are managed by the Illinois Department of Natural Resources, and are designated by Illinois River miles. Illinois River miles are measured from the confluence of the Illinois and Mississippi Rivers.
[h]Transect location not sampled because of low water.

Appendix B

List of Submersed and Floating-leaved Species Found During LTRMP Monitoring in Pools 4, 8, 13, and 26 of the Mississippi River and La Grange Pool of the Illinois River, 1991–1997.[a]

Family	Code	Scientific name	Common name
Azollaceae	AZME, AZCA	*Azolla* spp.[b]	watervelvet, mosquitofern
Ceratophyllaceae	CEDE4	*Ceratophyllum demersum* L.	coontail, coon=s tail
Characeae	CHAR	*Chara* spp.	chara
Characeae	NITE	*Nitella* spp.	nitella
Haloragaceae	MYSI	*Myriophyllum sibiricum* Komarov	northern watermilfoil, short spike watermilfoil
Haloragaceae	MYSP2	*M. spicatum* L.	Eurasian watermilfoil, spike watermilfoil
Hydrocharitaceae	ELCA7	*Elodea canadensis* Michx.	Canadian waterweed
Hydrocharitaceae	ELNU2	*E. nuttallii* (Planch.) St. John [c]	western waterweed
Hydrocharitaceae	VAAM3	*Vallisneria americana* Michx.	wild celery, American eelgrass
Lemnaceae	LEMI3	*Lemna minor* L.[b]	lesser duckweed, small duckweed, common duckweed
Lemnaceae	LETR	*L. trisulca* L.[b]	star duckweed
Lemnaceae	SPPO	*Spirodela polyrhiza* (L.) Schleid.[b]	greater duckweed, big duckweed, common duckweed
Lemnaceae	WOBR	*Wolffia braziliensis* Weddell[b] synonymy *W. papulifera* C. Thompson and *W. punctata* Griseb.	Brazillian watermeal
Lemnaceae	WOCO	*W. columbiana* Karst.[b]	Columbian watermeal
Lentibulariaceae	UTMA	*Utricularia macrorhiza* Le Conte, synomny *Utricularia vulgaris* L.	common bladderwort
Najadaceae	NAFL	*Najas flexilis* (Willd.) Rostkov and Schmidt	bushy pondweed, slender naiad, nodding waternymph
Najadaceae	NAGR	*N. gracillima* (A. Braun ex Engelm.) Magnus	slender waternymph
Najadaceae	NAGU	*N. guadalupensis* (Spreng.) Magnus[d]	southern waternymph
Najadaceae	NAMI	*N. minor* All.	brittle waternymph
Nymphaeaceae	NELU	*Nelumbo lutea* Willd.	American lotus
Nymphaeaceae	NULU	*Nuphar variegata* Durand synonymy *N. lutea* (L.) Sm.[e]	yellow pondlily
Nymphaeaceae	NYOD	*Nymphaea odorata* Ait. synonymy *N. tuberosa* Paine	American white waterlily
Onagraceae	LUDE4	*Ludwigia decurrens* Walt.[c]	wingleaf primrosewillow

Family	Code	Scientific name	Common name
Pontederiaceae	ZODU	*Heteranthera dubia* (Jacq.) MacM. synonymy *Zosterella dubia* (Jacq.) Small	water stargrass, grassleaf mudplantain
Potamogetonaceae	POAL8	*Potamogeton alpinus* Balbis[c]	red pondweed, alpine pondweed
Potamogetonaceae	POCR3	*P. crispus* L.	curly pondweed, curlyleaf pondweed
Potamogetonaceae	POEP2	*P. epihydrus* Raf.	ribbonleaf pondweed
Potamogetonaceae	POFO3	*P. foliosus* Raf.	leafy pondweed
Potamogetonaceae	POGR8	*P. gramineus* L.	variableleaf pondweed
Potamogetonaceae	POIL	*P. illinoensis* Morong.	Illinois pondweed
Potamogetonaceae	PONO2	*P. nodosus* Poir	river pondweed, American pondweed, longleaf pondweed
Potamogetonaceae	POPE6	*P. pectinatus* L	sago pondweed
Potamogetonaceae	POPU7	*P. pusillus* L.	small pondweed, slender pondweed
Potamogetonaceae	PORI2	*P. richardsonii* (Benn.) Rydb.	Richardson=s pondweed
Potamogetonaceae	POZO	*P. zosteriformis* Fern.	flatstem pondweed
Ranunculaceae	RAFL	*Ranunculus flabellaris* Raf.	yellow water buttercup
Ranunculaceae	RALO2	*R. longirostris* Godr.[f]	longbeak buttercup
Zannichelliaceae	ZAPA	*Zannichellia palustris* L.	horned pondweed

[a] Scientific nomenclature and common names follow the U.S. Department of Agriculture Internet PLANTS Database (1996).
Common names used by Upper Mississippi River managers are also included.
[b] Species excluded from analysis.
[c] Species verified by Dr. C.B. Hellquist, North Adams State College, Massachusetts.
[d] Species verified for Pool 13 by Dr. E. Cawley, Loras College, Iowa, and for Pool 8 by Dr. C. B. Hellquist, North Adams State
College, Massachusetts.
[e] Scientific nomenclature follows Gleason and Cronquist (1991). *Nuphar lutea* spp. *variegata* in PLANTS database.
[f] *Ranunculus longirostris* and *R. trichophyllus* were combined (Voss 1985).

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